INTERESTED?

The *Productivity & Interior Environments* reports offer valuable data and compelling insights into the effects of commercial building systems on individual performance and organizational productivity.

Who will benefit from these reports?

- Facility owners and managers concerned with offering tenants a high-quality workplace
- School facility administrators and teachers who want to improve learning environments
- Retailers wishing to understand the effects of daylight on sales
- Managers interested in the links between worker performance and indoor environments
- Policymakers and leaders in building standards and technologies
- Building-science and human-health researchers

Key next steps include:

- *Building owners, managers & designers:* Use daylighting with lighting controls in stores and classrooms. Design classrooms and offices with views from windows. Check with utility companies for efficiency program information.
- *Policymakers:* Promote building practices that save energy and enhance productivity and health.
- *Researchers:* Support the development of better indoor environmental monitoring and assessment tools.

This project was part of the *Integrated Energy Systems: Productivity & Building Science* program. To learn more, visit www.newbuildings.org/pier.

Funded by the
California Energy Commission
Public Interest Energy Research Program

Contact information:

California Energy Commission
www.energy.ca.gov/pier
Don Aumann
daumann@energy.state.ca.us

New Buildings Institute
www.newbuildings.org
Cathy Higgins
higgins@newbuildings.org

Heschong Mahone Group
www.h-m-g.com
Lisa Heschong
lheschong@h-m-g.com

Reports are available at
www.newbuildings.org/pier or
www.energy.ca.gov/pier
or call 916-654-5200

Rev October 2003

PRODUCTIVITY & INTERIOR ENVIRONMENTS

FOUR NEW STUDIES ON BUILDINGS AND HUMAN PERFORMANCE

Does Daylighting Improve Productivity?

Daylighting can reduce electric lighting use and utility bills. Another strong motivation for using daylighting in commercial buildings is increasing the productivity of activities occurring in the space, such as student learning, worker efficiency, or retail sales.

A landmark study completed in 1999 showed a positive correlation between daylighting and student performance on standardized tests. Similarly, a 1998 study demonstrated an increase in retail sales in daylit stores. These findings were significant, but the studies raised new questions.

This PIER research was undertaken to expand the prior results and address unresolved issues. These four studies shed new light on the link between productivity, daylighting and other indoor environmental conditions.

The Windows & Offices study correlated worker performance with indoor environmental conditions such as views from windows

Productivity & Interior Environments

This project consisted of four studies addressing productivity and interior environments in three market sectors—schools, retail stores, and offices.

Key results:

- The Daylighting in Schools Reanalysis study confirmed that **daylighting is a strong indicator of student performance**.
- The Windows & Classrooms study found that **students in classrooms with views from windows perform better** on math and reading tests.

Besides reducing utility bills, daylighting may increase retail sales

- The Daylighting & Retail Sales study found that a major retailer experienced up to **6% increase in sales in their daylit stores** compared to non-daylit stores.
- A study of office workers found that **daylight illumination levels were significant and positive in predicting better performance** on a test of mental function and attention. Ample and pleasant **views** were consistently associated with better performance, while **glare** from windows decreased performance.

Saving Energy and Improving Performance

These studies help establish a link between the built environment, the public benefits of reduced energy use, and the benefits of improved health and well-being.

Daylighting and automatic lighting controls can yield significant energy savings

If new buildings in California were designed with daylighting and lighting controls, the following statewide energy savings could be achieved (assuming a 10% market penetration the first year and an increase of 1% per year over the next 10 years):

- **Schools.** Ten-year cumulative electricity savings: 23,595 megawatt-hours (MWh). Savings: $3 million.
- **Retail.** Ten-year cumulative electricity savings: 562,467 MWh. Savings: $77 million.
- **Offices.** Ten-year cumulative electricity savings: 177,535 MWh. Savings: $24 million.
- **Total statewide benefits:** Ten-year cumulative electricity savings for these three sectors: 748,397 MWh. Savings: $103 million.